

Supplementary Information

Source, Impact and Removal of Malodour from Soiled Clothing

Chamila J. Denawaka, Ian A. Fowlis and John R. Dean*

Department of Applied Sciences, Northumbria University, Newcastle upon Tyne NE1 8ST, UK.

* Corresponding author: John R. Dean. Tel. No. +44 191 227 3047; email: John.Dean@northumbria.ac.uk

Table S1. Detailed information of quantification results for the individual compounds detected from socks

(a) Dimethyl disulphide

Participant code	Sock section #	Amount (ng/g)	Mean (n = 3) (ng/g)		Amount (ng/g)	Mean (n = 3) (ng/g)		Amount of reduction (ng/g)	% reduction	Mean % reduction (n = 3)
		Pre-wash (dry)			Post-wash (damp)					
A	1	1300			252			1048	81	
	2	1170			333			838	72	
	3	1390	1287 ± 111		211	265 ± 62		1179	85	79
B	1	243			185			58	24	
	2	250			165			85	34	
	3	294	262 ± 28		184	178 ± 11		110	37	32
C	1 / 2 / 3	ND			ND					
D	1	949			141			808	85	
	2	1001			269			732	73	
	3	831	927 ± 87		254	221 ± 70		577	69	76
E	1	446			188			258	58	
	2	432			93			339	79	
	3	387	422 ± 31		94	125 ± 55		293	76	71
F	1	234			72			162	69	
	2	262			84			178	68	
	3	160	219 ± 53		66	74 ± 9		94	59	65
G	1	114			54			60	53	
	2	281			63			218	78	
	3	360	252 ± 126		45	54 ± 9		315	87	73
H	1	1133			207			926	82	

(b) Dimethyltrisulphide

Participant code	Sock section #	Amount (ng/g)	Mean (n = 3) (ng/g)		Amount (ng/g)	Mean (n = 3) (ng/g)		Amount of reduction (ng/g)	% reduction	Mean % reduction (n = 3)
		Pre-wash (dry)			Post-wash (damp)					
A	1	15.3			3.6			11.7	77	
	2	15.2			4.5			10.7	71	
	3	22.3	17.6 ± 4.1		4.2	4.1 ± 0.5		18.1	81	74
B	1 / 2 / 3	ND			ND			ND	ND	ND
C	1	14.0			2.5			11.5	82	
	2	12.6			0.2			12.4	98	
	3	13.3	13.3 ± 0.7		1.0	1.2 ± 1.2		12.3	93	91
D	1	23.5			0.8			22.7	97	
	2	35.3			ND			35.3	100	
	3	22.2	27.0 ± 7.2		4.8	2.8 ± 2.8*		17.4	78	92
E	1	36.6			3.7			32.9	90	
	2	52.4			4.6			47.8	91	
	3	47.3	45.4 ± 8.1		4.3	4.2 ± 0.5		43.0	91	91
F	1	29.9			3.6			26.3	88	
	2	31.6			1.5			30.1	95	
	3	26.0	29.2 ± 2.9		1.0	2.0 ± 1.4		25.0	96	93
G	1 / 2 / 3	ND			ND			ND	ND	ND
H	1	45.6			4.1			41.5	91	
	2	31.3			5.8			25.5	81	
	3	48.0	41.6 ± 9.0		3.7	4.5 ± 1.1		44.3	92	88

Participant code	Sock section #	Amount (ng/g)	Mean (n = 3) (ng/g)		Amount (ng/g)	Mean (n = 3) (ng/g)		Amount of reduction (ng/g)	% reduction	Mean % reduction (n = 3)	
		Pre-wash (dry)			Post-wash (damp)						
A	1	300			112			188	63		(c) Butyric acid
	2	599			113			486	81		
	3	504	468 ± 153		109	111 ± 2		395	78	74	
B	1	270			93.8			176	65		
	2	477			98.9			378	79		
	3	487	411 ± 123		107	100 ± 7		380	78	74	
C	1	600			113			487	81		
	2	533			83.0			450	84		
	3	563	565 ± 30		70.1	88.7 ± 22.0		493	87	84	
D	1	138			69.3			69	50		# sock section: 1 = toe; 2 = ball ; and 3 = heel.
	2	263			78.3			185	70		
	3	222	208 ± 64		104	83.9 ± 18.0		118	53	53	
E	1	1314			105			1209	92		
	2	1772			99.1			1673	94		
	3	1573	1553 ± 230		104	103 ± 3		1469	93	93	
F	1	568			121			447	79		
	2	592			102			490	83		
	3	527	562 ± 33		85.1	103 ± 18		442	84	82	
G	1	564			103			461	82		
	2	609			94.0			515	84		

* n = 2

ND = not detected; below the LOQ (see Table 2)

Table S2. Quantitative results for VCs in t-shirt sub-samples pre-wash (dry), post-wash (damp) and post-wash (dry)

(a) Dimethyl trisulphide

Participant code	Section number	Amount (ng/g)	mean $\pm$ SD	Amount (ng/g)	Mean $\pm$ SD	Mean % reduction	Amount (ng/g)	Mean $\pm$ SD	Mean % reduction [*]
		Pre-wash (dry)		Post-wash (damp)			Post-wash (dry)		
M1	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M2	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M3	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M4	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M5	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M6	1	15.6	22.3 $\pm$ 6.0	19.6	19.8 $\pm$ 0.2	11.2	19.9	16.7 $\pm$ 4.7	25.1
	2	24.4		19.8			19.0		
	3	27.0		19.9			11.3		
M7	1	13.0	14.2 $\pm$ 1.0	11.2	6.8 $\pm$ 3.8	52.1	12.0	10.2 $\pm$ 2.6	28.2
	2	14.9		4.3			11.3		
	3	14.6		4.9			7.2		
M8	1	18.4	21.3 $\pm$ 6.8	6.3	4.7 $\pm$ 1.6	77.9	10.6	11.1 $\pm$ 4.8	47.9
	2	29.0		4.6			16.1		
	3	16.5		3.1			6.6		
M9	1	17.2	20.8 $\pm$ 5.4	3.2	3.5 $\pm$ 0.3	83.2	3.4	3.6 $\pm$ 0.8	82.7
	2	26.9		3.7			3.1		
	3	18.2		3.4			4.5		

* relative wash
ND = not detected

to Pre-
(Damp)

(b) 2-heptanone

Participant code	Section number	Amount (ng/g)	mean $\pm$ SD	Amount (ng/g)	Mean $\pm$ SD	Mean % reduction	Amount (ng/g)	Mean $\pm$ SD	Mean % reduction*
		Pre-wash (dry)		Post-wash (damp)			Post-wash (dry)		
M1	1	0.50	0.52 $\pm$ 0.04	0.20	0.22 $\pm$ 0.03	57.7	0.11	0.12 $\pm$ 0.01	76.9
	2	0.51		0.24			0.12		
	3	0.56		-					
M2	1	0.45	0.40 $\pm$ 0.05	0.23	0.23 $\pm$ 0.03	42.5	0.07	0.07 $\pm$ 0.03	82.5
	2	0.34		0.21			0.04		
	3	0.41		0.26			0.10		
M3	1	0.68	0.72 $\pm$ 0.18	0.44	0.47 $\pm$ 0.07	34.7	0.11	0.25 $\pm$ 0.13	65.3
	2	0.57		0.42			0.27		
	3	0.91		0.55			0.36		
M4	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M5	1	0.59	0.59 $\pm$ 0.01	0.17	0.19 $\pm$ 0.07	67.8	0.14	0.08 $\pm$ 0.05	86.4
	2	0.57		0.27			0.05		
	3	0.59		0.14			0.06		
M6	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M7	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M8	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M9	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND

*
to Pre-
(Damp)
ND =
detected

relative
wash
not

(c) **2-octanone**

Participant code	Section number	Amount (ng/g)	mean $\pm$ SD	Amount (ng/g)	Mean $\pm$ SD	Mean % reduction	Amount (ng/g)	Mean $\pm$ SD	Mean % reduction*
		Pre-wash (dry)		Post-wash (damp)			Post-wash (dry)		
M1	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M2	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M3	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M4	1	1.7	1.8 $\pm$ 0.15	0.95	1.06 $\pm$ 0.12	41.1	0.08	0.07 $\pm$ 0.01	96.1
	2	1.9		1.19			0.07		
	3	1.6		1.04			0.07		
M5	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M6	1 / 2 / 3	ND	-	ND	-	ND	ND	-	ND
M7	1	2.8	2.69 $\pm$ 0.06	1.29	0.66 $\pm$ 0.56	75.5	0.13	0.10 $\pm$ 0.02	96.3
	2	2.6		0.44			0.10		
	3	2.7		0.25			0.08		
M8	1	2.5	2.73 $\pm$ 0.28	0.63	0.48 $\pm$ 0.22	82.4	0.10	0.08 $\pm$ 0.03	97.1
	2	3.0		0.32			0.09		
	3	2.7		ND			0.05		
M9	1	2.6	2.6 $\pm$ 0.07	0.38	0.27 $\pm$ 0.11	89.6	0.05	0.05 $\pm$ 0.01	98.1
	2	2.7		0.25			0.04		
	3	2.7		0.17			0.05		

*

relative to Pre-wash (Damp)

ND = not detected

(d) 2-nonanone

Participant code	Section number *	Amount (ng/g)	mean $\pm$ SD	Amount (ng/g)	Mean $\pm$ SD	% reduction	Amount (ng/g)	Mean $\pm$ SD	Mean % reduction*
		Pre-wash (dry)		Post-wash (damp)			Post-wash (dry)		
M1	1 / 2 / 3	ND	ND	ND	ND	ND	ND	ND	ND
M2	1 / 2 / 3	ND	ND	ND	ND	ND	ND	ND	ND
M3	1 / 2 / 3	ND	ND	ND	ND	ND	ND	ND	ND
M4	1	0.88	0.90 $\pm$ 0.05	ND	ND	ND	ND	ND	ND
	2	0.87		ND	ND	ND	ND	ND	ND
	3	0.96		0.09	-		0.02		
M5	1	0.67	0.66 $\pm$ 0.15	0.13	0.09 $\pm$ 0.05	86.4	ND	ND	ND
	2	0.51		0.04			0.03	0.03 $\pm$ 0.01	-
	3	0.80		ND	ND	ND	ND	ND	ND
M6	1 / 2 / 3	ND	ND	ND	ND	ND	ND	ND	ND
M7	1	0.98	1.03 $\pm$ 0.11	ND	ND	ND	ND	ND	ND
	2	1.15		ND	ND	ND	ND	ND	ND
	3	0.95		ND	ND	ND	ND	ND	ND
M8	1	0.82	0.81 $\pm$ 0.07	ND	ND	ND	ND	ND	ND
	2	0.88		ND	ND	ND	ND	ND	ND
	3	0.74		ND	ND	ND	ND	ND	ND
M9	1	0.28	0.53 $\pm$ 0.36	ND	ND	ND	ND	ND	ND
	2	0.94		ND	ND	ND	ND	ND	ND
	3	0.36		ND	ND	ND	ND	ND	ND

* relative to Pre-wash (Damp)

ND = not detected